

Extending the Applicability of Intrinsic Remediation to A Wide Range of Synthetic Chemicals

The potential for intrinsic remediation of biodegradable contaminants should be considered before more costly and disruptive treatment options

The Challenge

Intrinsic remediation is now an accepted remedial option for fuel hydrocarbons. The Air Force and EPA protocol for intrinsic remediation of petroleum hydrocarbons is widely applied. Intrinsic remediation of chlorinated aliphatic compounds has been extensively studied and a draft protocol is being tested at several Air Force sites. The current challenge is to extend the applicability of intrinsic remediation to a wide range of synthetic chemicals known to be biodegradable.

Technology Expansion

Many compounds are potential candidates for intrinsic remediation. Common soil microorganisms can grow on some of these compounds. For some synthetic compounds, the microbes are not widely distributed but are limited to specialized ecosystems, such as contaminated sites or industrial facilities.

Candidate Compounds for Intrinsic Remediation

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|------------------------------|----------------------|
| • Acetone | • 1,2-Dibromoethane |
| • Methyl ethyl ketone | • PCB's |
| • Chlorobenzene | • Nitrobenzene |
| • Dichlorobenzenes | • Nitrotoluenes |
| • 1,2,4-Trichlorobenzene | • Dinitrotoluenes |
| • 1,2,4,5-Tetrachlorobenzene | • 1,3-Dinitrobenzene |
| • Chlorophenols | • Nitrophenols |
| • Pentachlorophenol | • 2,4-Dinitrophenol |
| • Methylene chloride | • Picric acid |
| • 1,2-Dichloroethane | • Nitrobenzoic acids |
| • Pesticides | • Nitroglycerin |
| • Aniline | |

Chlorobenzene Biodegradation

AFRL/MLQ has focused on the biodegradation of chlorinated aromatic compounds. All chlorinated aromatic compounds can be mineralized, but the bacteria responsible are only found in specialized ecosystems. Intrinsic remediation requires that degradative functions become prevalent in the indigenous soil community. AFRL/MLQ has analyzed dichlorobenzene-contaminated groundwater from a variety of sites and adjacent uncontaminated sites. Under anaerobic conditions, dichlorobenzenes can be dechlorinated to chlorobenzene (CB). The final dechlorination step, the conversion of CB to benzene, has not been reported but is being investigated by Cornell University.

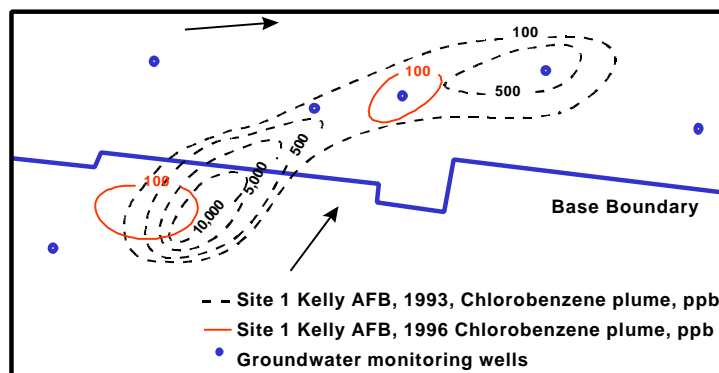
Across the Country

One of the three lines of evidence needed to support intrinsic remediation is direct microbiological evidence of contaminant degradation. To determine if CB-degrading bacteria exist at CB contamination sites, groundwater samples were taken from seven sites across the country (Kelly AFB, TX; Robins AFB, GA; Plattsburgh AFB, NY; DoE Savannah River Site; three private industrial sites). Five sites had CB-degrading bacteria within the contaminated plume but not in adjacent uncontaminated areas. Two sites contained no CB-degrading

bacteria. These two sites only contained small amounts (ppb) of CB in anaerobic zones and seemed not to be undergoing intrinsic remediation. This survey by AFRL/MLQ revealed that CB-degrading bacteria can be isolated from contaminated sites where CB degradation is taking place. CB-degrading bacteria were not detected in nearby uncontaminated areas nor in contaminated plumes where no CB degradation was evident. Current efforts by AFRL/MLQ are now focused at Kelly AFB conducting an in-depth intrinsic remediation study.

Kelly AFB, Texas

The second and third lines of evidence needed to support intrinsic remediation are field-scale-documented loss of contaminants, and contaminant and geochemical data.



The figure above depicts a CB groundwater contamination plume at Kelly AFB in 1993 and 1996. The size of the plume has decreased dramatically. Some off-base, previously contaminated wells now show no traces of CB. The discovery of substantial populations of CB-degraders in the contaminated areas provides strong evidence of intrinsic remediation of CB. A treatability study to examine the potential for intrinsic remediation for CB was initiated in October 1997. Results from the treatability study are now available. A second treatability study at Robins AFB, GA, was initiated in September 1998.

Payoff

The application of intrinsic remediation to sites contaminated with a wide range of synthetic compounds, will allow the Air Force, DOD, and private industry to realize multimillion dollar savings. The potential for intrinsic remediation of biodegradable contaminants should be considered before more costly and disruptive treatment options.

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